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## A literature review on implementation of Lean Manufacturing Techniques

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**Abstract:** In competitive environment lean manufacturing is necessary in every industry. Lean production is a standard manufacturing mode of the 21<sup>st</sup> century. Lean manufacturing have various synonyms like lean management, lean production, It is very use full techniques for reduce the flow of non value added time. Lean manufacturing is a philosophy to reduce the time between customer order and products are ready for the delivery by eliminating waste. Waste (muda) is a serious problem in to the industry it is creates a non value added services and poor quality of the product. Waste are seven type occurs in industry 1) transport,2) inventory,3)motion,4) waiting,5) over production,6) over processing,7) defect. It is eliminate with the help of lean manufacturing. It is an integrated system that gives production of goods/services with minimum buffering costs. This paper gives the literature survey on various type of industry to apply the lean manufacturing, like apply in to automobile industry, and pharmaceutical company, cotton seed oil industry, health care hospital. And also refers other 5 papers gives the information about lean manufacturing and discussion. And introducing about lean .what is lean manufacturing, why it is needed, and method of lean manufacturing that reduces waste. And also to introduces about different lean tools.

**Keywords:** lean manufacturing, kaizen, kanban, JIT, VSM, 5s

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### I. INTRODUCTION

The term lean production was first used by Krafcik (1988) and it was drawn from the famous book titled The Machine that Changed the World: The Story of Lean Production (Womack et al., 1990).[9] Lean production is rooted in the Toyota production system and primarily aims at the elimination of waste (muda). Taiichi Ohno defined “muda” as any human activity, which absorbs resources but creates no value. Lean manufacturing is defect reduction and inventory control, reduce lead time, and change over time, Lean production using half of the human effort in the factory,[15] Lean manufacturing is flexible manufacturing techniques. And reduce the 50% of human efforts.

**Lean manufacturing tools:**

There are various type of lean tools are available and use this tools and principal, like cellular manufacturing, JIT, continuous improvement, production smoothing, standardization of work, total productive maintenance(TPM), SMED, etc.. We are understood about lean tool one by one in shortly.

**Cellular manufacturing:**

Cellular manufacturing reduce the transportation waste. And reduce the inventory. Cellular manufacturing also says “one piece flow” process. It is difficult to fulfill the customer requirement with traditional product line, so using the U- shape product line replace traditional product line.[15]

**Just in time (JIT):**

Just in time is a heart of the lean manufacturing. It’s associated with lean techniques. Just in time production gives right part at the right place at right time.

Kanban system, Production smoothing, and setup time reduction are component of any JIT system. “kanban” is a Japanies word which means card or signal. Which process is running and give the basic information about manufacturing.

There are two types of kanban.

- Single Card Kanban System and
- Double Card Kanban System

**Single Card Kanban System:** In a single card kanban system parts are produced and brought according to a daily schedule and deliveries to the user are controlled by c- kanban.

Double card kanban system:

C- kanban and

P- kanban.

C- kanban: Gives signal for deliver more parts to the next process.

P- kanban: Gives the signal for require more parts.[15]

**Production Smoothing:** Production smoothing is the process of the balance the work load over different time period. It provide flexibility to respond rush order.[18] it is help to eliminate over production.

**Total productive maintenance (TPM):** Total productive maintenance is the techniques for reducing the machine down time and eliminates the defect and scrap. TPM is a fundamental pillar of lean. It is introducing awareness of self maintenance and also introducing the preventive maintenance of machine. [13]

**Continuous Improvement:** Continuous improvement such as improve the quality of product and customer satisfaction. Kaizen and 5s are the component of continuous improvement.

**Kaizen:** Kaizen is a Japanese word kai means continuous and zen means improvement, so its English translation is continuous improvement. Its main focus on completely improve the product and satisfy the customer.

**5s :** It has a five stage of the improvement of the process. It has five “S” all “S” gives the different meaning and activity. Seiri, Seiton, Seiso, Seiketsu, and Shitsuke. Is a Japanese word and translate into English These 5S is: Sort, Set (in place), Shine, Standardize, and Sustain.[7]

**Table I:** For the 5s detail. [7]

First ‘S’	Seiry	sort	Sorting out of the necessary parts.
Second ‘S’	Seiton	Set	All the parts arrange of its proper place.
Third ‘S’	Seiso	Shine	All working area keep clean
Forth ‘S’	Seiketsu	Standardize	It is standardize clean up
Fifth ‘S’	shitshuke	Sustain	Keep discipline

**Value stream mapping:** Value stream mapping(VSM) is a paper pencil tool it is identify the value of added and non added. Its is visual representation of material flow and information flow. Value stream mapping creates a two maps starting with current state map it gives the snapshot of assembly which process running. And after second one is create a future state map for the improvement of the process.[13]

### **What is lean manufacturing?**

Lean manufacturing is a system that integrates the daily work of producing and delivering products, services, and information of the problem identification and process improvement to eliminate waste and reduce production lot sizes.[19]

Lean manufacturing is the main aim of the high quality, low cost, and just in time delivery by shortening the production flow by eliminating waste. Lean manufacturing is a team base structure. It breaks down organizational barrier and develops highly trained and motivated employees who investigate problems and find solutions as a part of their job.[19]

Lean manufacturing is an integrated socio technical system whose main objective is to eliminate waste by concurrently reducing and minimizing supplier, customer, and internal variability.[13]

### **Why it's needed:**

In today's competition is very increase in business. And customers are more and more aspect for the quality in product so that, standing with other competitors; it is needed to implement the lean manufacturing technique. Because it's give the better quality of product and customer satisfaction. Without any investment and Also it's excess of inventory and reduce the cost or non value added activity with the help various lean tools, lean manufacturing also reduce the seven type waste occurring in industry. Like (1) Transport (2) Inventory (3) Motion (4) waiting (5) over processing(6)Over production (7) Defect. It is reducing with the help of various lean tools and principal are listed following.

5s, OEE (over all equipment effectiveness), 8 step practical problem solving (PPS),Pareto analysis, elimination of waste, kaizen, setup time reduction, process mapping, value stream mapping(VSM), quick and easy kaizen, SPC/control charting, 5 why, autonomation, continuous improvement, continuous flow, visual control, design for six sigma(DFSS), cellular manufacturing, production leveling, kanban, line balancing, voice of the customer, Jidoka, Anova, Work standardization, work simplification, fish born diagram, six sigma, takt time, pokayoke/ mistake proofing, it is all lean tools are depend on the industry and industry problem which tools are apply and get a maximum benefits.[7]

### **Method of lean manufacturing:**

Method for lean manufacturing is implementation in industry consider some steps are to be taken as following.

- (1) Select the target or product.
- (2) Gemba walk, for the collecting data and all the data from product line and industry
- (3) Prepare a chart or map for the analyzing data and take decision where is the maximum waste or non value added flow, with the help measuring lead time, cycle time, number of workers, and inventory, we are also used the current state map method from VSM.
- (4) And after completely understand about the waste or non value added, so that decide the lean tools which lean tools apply and give maximum result, Depend on the waste. like tools are 5s- for the decrease the waiting time, cellular manufacturing focus on industry, SMED- reduce the time consuming by change over time and setup. JIDOKA- set of practice, mistake proofing and automation, kaizen for continuous improvement.
- (5) And last one step is improving the problem and gives continuous improvement in future for industry and get increase profit of the industry.

## **II. LITERATURE REVIEW:**

As a lean manufacturing is a technique to reduce human efforts and produce defect free product. According to Jafri Mohd Rohani et.al. are production line analysis via value stream mapping for color industry, in this article identify and eliminate waste by using team formation, product selection, conceptual design, and time frame formulation through takt time calculation. And use the some lean techniques change over time and 5s and decreased lead time from 8.5 days to 6 days and value aided time decrease from 68 minutes to 37 minuts. Tomas Rohac et.al.(2015) to demonstration with value stream mapping on the plastic

product of health care to applying lean tools are 5-why & Ishikawa chart, and reduce the lead time and inventory control.

Pravin shaswat et al.(2015) apply the value stream mapping on bearing industry and reduce the work in process and inventory and lead time. In this article gives the information about value stream mapping and gives the methodology for the implementation of VSM. In this case study paper to apply the 5s and kanban system for the reduction of work in process inventory and lead time.

According to Taho yang yiyo kag (2014) suggested and implement lean production system for fishing net manufacturing, use the various lean tools and Simulation method and make to order (MTO) process are apply for the regular shipment. And also use the VSM tool and produce future state map and increase service level and reduce lead time, also says that gives the guide line for the implement the value stream mapping. How to implement VSM and which factor to be consider, and after says that lean manufacturing are apply in any manufacturing industry successfully and reduce cost by elimination of waste.

Santosh kumar et, al.(2014) apply the lean tool by method time measurement and line balance efficiency and reduce the cycle time in a truck body assembly line and improve efficiency in that product line. Also says that lean manufacturing is a business philosophy that continuously improves the process involve in manufacturing.

According to K. Venkataraman(2014) says that various organizations are implement lean manufacturing in recent year for reducing and eliminate waste. In this article use the value stream mapping for reducing cycle time of crank shaft. Various type of tools are apply and get benefits, create a current state map of the crank shaft assembly line and also creates a future state map for improving process of crank shaft assembly, here is a three assembly available for producing a crank shaft. And improve the process and reduce waste so that apply three type kaizen, and also used the analytical hierarchical process(AHP) for decision making which process are apply and after than get result of the crank shaft assembly to reduce the inventory, and apply the single piece flow for crank shaft manufacturing and give quick response to the customer demand.

P. Arunagiri et, al. (2014) identification of high impact lean tool in auto mobile industry using weighted average method and they study about 91 industry and using 30 or more lean tools used get a result by weighted average method to maximum useful tools in automobile industry, first one is 5s lean tool are preferred to elimination waste.

Also Ratneshwar singh et,al.(2013) . TPM implementation in machine shop and reduce break down time and improve performance efficiency. TPM depend on various pillar, like 5s, jishu- hozen, planned maintenance, quality maintenance, kaizen office, and safety, health & environment are apply one by one and improve the quality of product with over all equipment effectiveness.

Boppana v. chaudhary et, al. (2012), implement the lean manufacturing in a pharmaceutical company, in this paper take a case study of the product line is creams and ointment. Also in industry problem was fixed operating cost and inability to supply products. In this paper improve the operation with help of lean manufacturing so detect the problem where is the waste are occurs, and use the lean tools is VSM. VSM is a mapping method, with the help of detecting value added and non value added process. Prepare a current state map and use the 5-why method for the collect information. And after create future state map for the improvement with the help of 5s tool. and also used cellular manufacturing and after get the result is reduce inventory, and customer satisfaction, and on time delivery, total cycle time reduced , non value added time has been decrease. And reduced the floor space area.

Jennies angelis et, al.(2012) Lean is a globally competitive standard for product assembly of discreet parts. Successful Lean application is conditioned by an evolutionary problem-solving ability of the rank and file. This is in itself contingent on employee involvement in improvement programs and the implementation of appropriate practices.

Rachna shah et.al. 2007 Lean manufacturing is an integrated socio technical system whose main objective is to eliminate waste by concurrently reducing and minimizing supplier, customer, and internal variability.

And according to Horacio Soriano-meier et.al.2001 Lean manufacturing and lean production is a synonyms of lean management. Lean manufacturing can be achieved through time. that is not possible to use it as a panacea to solve short term competitive. And also lean manufacturing is applied in any industry. In this article applying lean management for the hospital and improve the quality of the service, and give customer satisfaction and service of the patient. All the improvement are success by lean tools, in this study apply the

lean tool kaizen for the improving the service level and 5s are also apply for cleaning and systematic activities.

According to dinesh seth at.el. lean manufacturing is the systematic approach to identify and eliminating waste by continuous improvements. In this paper minimize the waste in the cotton seed oil industry with the help of value stream mapping tool. Methodology in this paper to take a survey of Indian cotton oil seed industry and take a sample from India and prepare a questioner and get feedback by phones and emails. And after prepare overall supply chain mapping and identified the waste and eliminate it with some modification and improve the productivity.

### III. SUMMARY OF LITERATURE REVIEW AND DISCUSSION:

There are different papers are referred on lean, and selecting the some papers from all areas to apply lean manufacturing like automobile industry, pharmaceutical company, color industry, cotton seed oil industry, health care hospital, and 5 paper discussion for the lean manufacturing and this study concludes from this literature review to various lean tool apply in different industry as per requirement but Value stream mapping techniques and 5s tool are much effective and use full tool for the detection of waste and improvement of the process. And also lean manufacturing techniques are applying in any industry and derive benefits

Table. II. Summary of literature review

<b>Paper</b>	<b>Title</b>	<b>Journal</b>	<b>Product analyzed</b>	<b>Tool applied</b>	<b>Benefits derived</b>
1	Production line analysis via value stream mapping: a lean manufacturing process of color industry	Elsevier	Color industry	VSM 5s	Decrease lead time. Reduced value added.
2	Value stream mapping, demonstration on real case study.	Elsevier	Plastic product of health care	5-why Ishikawa chart	Reduced lead time. Inventory control.
3	Reduction of work in process inventory and production lead time in a bearing industry using value stream mapping.	IJMVSC	Bearing	VSM	Reduced work in process inventory. And lead time.
4	Lean production system design for fishing net manufacturing using lean principles and simulation optimization.	Elsevier	Fishing net	VSM	Increase service level. Reduced work in process.
5	Cycle time reduction of truck body assembly in automobile industry by lean principal.	Elsevier	Truck body	VSM Tree diagram	Reduced cycle time.
6	Application of value stream mapping for reduction of cycle time in a machining process.	Elsevier	Crank shaft	VSM KAIZEN	Eliminate inventory between two machines. Quik response to customer. Single piece Flow established.
7	Identification of high impact lean production	Elsevier	Auto mobile industry	Weighted average method	5s, OEE, 8 step problem solving

	tools in automobile industry using weighted average method.				method, pareto analysis, Elimination of waste, this five tools are very effective in lean production.
8	TPM implementation in a machine shop. case study	Elsevier	Auto mobile parts	5s Kaizen	Reduced break down time. Performance efficiency improves.
9	Improvement of manufacturing operation at a pharmaceutical company, a lean manufacturing approach	Emerald	pharmaceutical company product, Cream and ointments.	5-why VSM	Non value added decrease. Total cycle time reduced. Work forced reduced. Work in process reduction. Reduction of shop floor area. Reduction in floor space.

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